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PROPERTY RIGHTS AND RESIDENTIAL CAPITALIZATION RATES

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The level of property rights associated with a dwelling has important implications for its value, as has been demonstrated in the recent literature. What has not been investigated is whether property rights have different effects on rents than on values. This paper documents this difference in the case of one city in a developing country, Cairo, Egypt.

It is found that, while rents as a proportion of household incomes fall over the income distribution, unit values rise as a multiple of household incomes. Because tenure security almost always increases with income, this suggests that, rather than being constant within a market at a point in time, tenure security has the effect of raising the price of the housing stock relative to the price of the services produced by that stock for higher income households. Capitalization rates therefore tend to rise with income. Little evidence is available concerning the long-run behavior of housing values. The data that do exist are ambiguous.

The principal policy implication of this analysis is that the informal sector is both easier and more difficult to deal with than is often realized. It is easier in the sense that it reacts to the same stimuli as any other market. It is often a productive sector in which participants are willing to devote substantial amounts of their own resources to upgrading and improving their investment. In this sense, governments can best help by providing secure tenure and clear property rights, while devoting scarce resources to the poorest segments of the market.

It is more difficult because most governments will find it necessary to change their way of thinking to pursue this type of policy. Active public involvement to production and maintenance along with unrealistically high building and land use standards have been the midwife to the birth of the informal sector. They are unlikely to be a part of the solution.

What is true for governments is also true for international donor agencies. Successful housing projects in developing countries or former planned economies have to take the need for regulatory and institutional reform into account. If this is not considered, projects are unlikely to be successful in providing replicable improvements in the housing of low income households.

Finally, this paper asserts that capitalization rates are an important entry point for understanding housing markets. Although much of the literature on housing deals with the issue of tenure choice, there is an inadequate understanding of the forces which drive the relative prices of housing stock and the services they produce. An understanding of these forces is a key to an understanding of housing markets.

INTRODUCTION

The level of property rights associated with a dwelling has important implications for its value, as has been demonstrated in the recent literature. What has not been investigated is whether property rights have different effects on rents than on values. This paper documents this difference in the case of one city in a developing country, Cairo, Egypt.

An understanding of residential capitalization rates is central to understanding housing markets. A rent, denoting the price of the level of services produced by a unit over a certain period, and a value, denoting the price of the stock of housing services embodied in the unit, may be conceptually associated with any dwelling whether it is owner-occupied, rented, or a squatter unit.[1] The relationship between these two prices describes the relationship between the consumption of housing services and the portfolio choice inherent in the purchase of an owner-occupied home. This relationship is little understood, even though much of the housing literature concerns the question of tenure choice.

Capitalization rates can carry information on distortions in the housing market as well as on stability in the macroeconomy. In a world of perfect markets, the ratio of rents to values should be equal to the opportunity cost of capital, the interest rate. However, this ratio is often far lower than the prevailing interest rate, indicating that households are willing to accept seemingly low returns on their investment. This common phenomenon needs to be explained.

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[1] The term prices in this paper refers to either values or rents, as the price of the stock and the price of the service respectively.

Anecdotal evidence also suggests that values are subject to more violent swings than rents. It is argued here that this is due to the fact that values respond to changes in expectations concerning both future rents and the general economic environment.

There are growing literatures treating residential capitalization rates and the informal housing sector.[2] The former deals almost exclusively with developed, and the latter with developing countries.

The discussion of informal sector housing in developing countries as a market phenomenon began in the sociological literature.[3] This point of view represented a transition from the common earlier belief that squatter and informal dwellings are uniformly substandard and occupied by households perpetually marginalized from the mainstream economy toward understanding it as a rational economic response to the constraints faced by different economic actors in a way described below.[4]

The economic literature on this topic has illuminated a number of aspects of housing markets in developing countries which are key to understanding how they function and to defining appropriate policies. Renaud[1984] provides a description of the three-tiered nature of housing markets often found in developing countries. The first tier consists of high income, owner-occupied housing which complies with all relevant building and land use laws, and where the land is legally owned. The second tier is formal rental housing, often provided to government employees and workers for large, multi-national companies, often at highly subsidized rents. This is generally a narrow, middle income group. The final tier is informal housing, which includes unauthorized and squatter housing.

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[2] Capitalization rates are defined here as the ratio of a unit's value to its rent.

[3] See Peattie and Aldrete-Haas[1981] and Ward[1976].

[4] Tenure security is the term most often used in the development literature. However here the broader expression, property rights, is used. This can encompass the likelihood of eviction and expropriation as well as other rights embodied in different tenure modes.

Unauthorized housing consists of units on land which is legally owned, but which do not conform with building codes or land-use regulations. Squatter housing is located on illegally occupied land. The relative size and property rights associated with these subsectors are highly idiosyncratic between housing markets.[5]

The major finding of this literature is that informal markets function in much the same way as formal markets. What these markets do is provide housing where higher levels of risk, or in more general terms lower levels of property rights, are traded off against lower prices.[6] This allows lower income families to enter the market when they cannot afford prices of the formal sector. This does not mean that higher income households do not participate in these markets, although it has been found that units embodying higher levels of risk are more likely to be inhabited by low income households.[7]

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[5] See Mayo et al[1982] and De Soto[1989] for descriptions of housing markets where the prevalent form of informal housing is unauthorized and squatter respectively.

[6] The phrase "lower levels of property rights" means a number of things. In the most general sense, some level of property rights may be conceptually associated with any combination of a unit and occupant. This variable denotes characteristics such as control of density, access to credit using the unit as collateral, right to expand or upgrade the unit, and the right to value increases through sale or subletting the unit. It is not always obvious, a priori, to whom these rights belong. For example, if a tenant can sell the right to sublet the unit at a controlled rent, he or she has captured some of the rights more generally associated with an owner. See Chalamwong and Feder[1988], and U.S. Supreme Court[1992a,1992b].

Other important findings are that housing values and rents, although lower for informal than formal units, are not negligible. Some of these units are of quite high quality. Investment tends to be made incrementally, and private investment tends to lead provision of public services. This is especially true when risk of eviction is small.[8]

Informal sector housing markets are therefore a quite complicated and interesting phenomenon, but one which is adequately treated with standard economic techniques extended to treat property rights as a good which commands a price. There is no compelling case to view these informal markets as qualitatively different than any other market.

The literature on capitalization rates is both newer and smaller. It begins with Phillips[1988,1985a,1985b], where rent-to-value ratios are assumed to change only over time and across markets.[9] Linneman and Voith[1991] extend this to recognize that they can differ among units in a given place and time. They postulate that these rates are a function of the household's financial position.

Capitalization rates are an important missing dimension to the understanding of housing markets. The standard theory of capital suggests that unit values are directly derived from the stream of rents, and should therefore trace the same patterns across the income distribution and over time as do rents. In other words, capitalization rates should be constant. Anecdotal evidence, however, suggests that this might not be the case.[10]

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[7] See Friedman, Jimenez, and Mayo [1988].

[8] For descriptions of the incremental investment process see Renaud[1984], Mayo et al[1982], and De Soto[1989]. For a discussion of the value of informal units see Jimenez[1982].

[9] Some of the variables which Phillips postulates as affecting capitalization rates can differ among units within a given market and at a particular time, however her empirical framework suppresses these differences and only deals with market averages.

This paper examines the effects of property rights on capitalization rates in developing countries. Property rights are only one factor which can differentially affect the value of the housing stock and the value of the housing services produced by that stock. Other examples which have been suggested in the literature are maintenance costs, price stability, financing costs, alternative investment opportunities, real interest rates, and the income and age of the head of household.[11]

It is found that, while rents as a proportion of household incomes almost always fall over the income distribution, unit values sometimes rise as a multiple of household incomes, or at least fall more slowly than rents. Because tenure security almost always increases with income, this suggests that, rather than being constant within a market at a point in time, tenure security has the effect of raising the price of the housing stock relative to the price of the services produced by that stock for higher income households. Capitalization rates therefore tend to rise with income in the short-run.[12]

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[10] See Phillips[1988] and the references cited therein.

[11] See Phillips[1988,1985a,1985b] and Linneman and Voith[1991].

[12] There are other reasons why capitalization rates could rise with incomes, for example the dearth of alternative investments in developing countries. Price instability could also effect these rates within a market as increasing inflation could make higher priced dwellings seem more attractive as investments than lower income housing.

The remainder of this paper is structured as follows. Section One deals with the theoretical relationship between rents and values, and describes how tenure security might affect them. Section Two describes the data and survey, and discusses the proxy used for property rights. Section Three describes the empirical framework and Section Four the results. Section Five provides conclusions and policy prescriptions.

TENURE SECURITY AND CAPITALIZATION RATES

In many economic papers which discuss housing, rents and values are viewed separately. Much is known about how rents move over the income distribution and with economic development. There is, however, no similar consensus on the relationship between values and rents.

Figure 1 is reproduced from Malpezzi and Mayo[1985]. It illustrates a powerful empirical relationship between the ratio of rents to incomes within and across countries. The downward sloping lines represent the percentage of the household budget devoted to housing within a given market and at a point in time in four cities in developing countries. At lower levels of income, households must spend a higher proportion of household income on housing. In other words, housing demand is inelastic in the short run.[13]

The upward sloping line is a regression line connecting the average rent to income ratios in a sample of fourteen cities in developing countries. As average income increases, the average rent to income ratio also increases, implying that as a country's income increases in the long run, housing demand is

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[13] This statement is based on estimates of elasticities of demand contained in an early, unpublished version of Malpezzi and Mayo[1985] where short run elasticities were estimated.

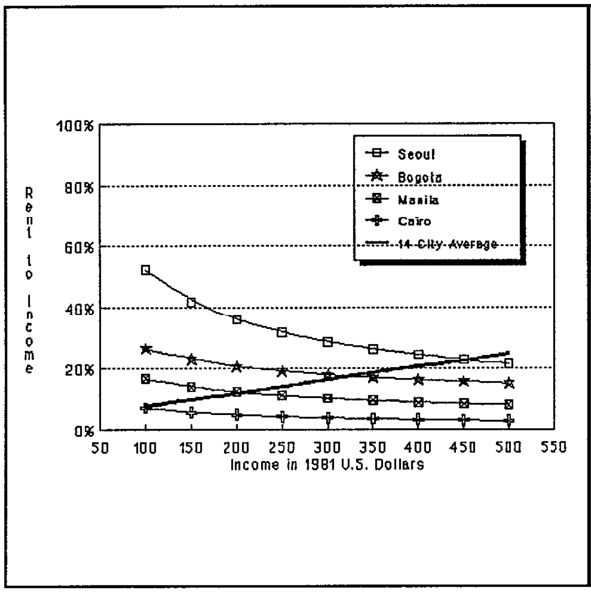

Figure 1

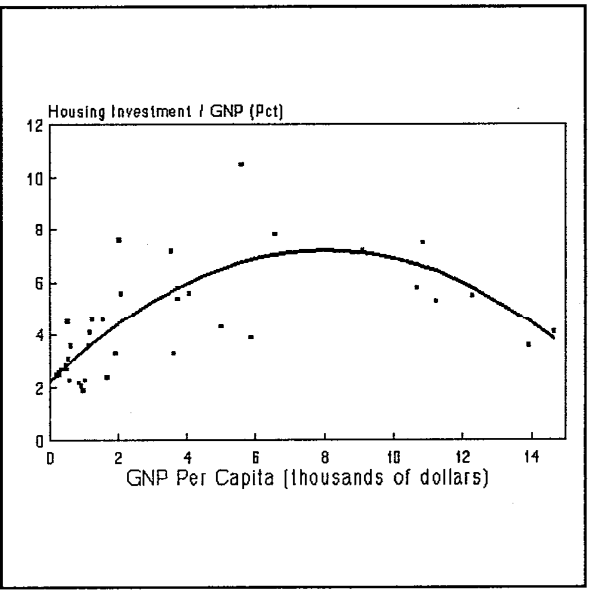

Figure 2

elastic. As development proceeds and incomes increase, households can substitute resources from food purchases to housing.[14]

There is no corresponding empirical model which explains the relationship of values to incomes or rents over the income distribution or different levels of economic development. The standard theory of capital valuation applied to housing implies the value of a unit is equal to the discounted stream of future rents.

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[14] See World Bank[1992], Annex 1 for further discussion. Note that eventually this curve turns back downward as incomes increase still further and households can transfer resources from housing to other goods such as consumer durables, health care, and education. This is illustrated by a similar relationship which appears in Figure 2, taken from Burns and Grebler[1976], and graphs housing investment as a percentage of GNP against GNP per capita. Renaud[1991] points out that, in order for this downturn to occur, supply has to be more responsive than demand to price changes, i.e. $\eta < \epsilon_s + \epsilon_d$, where $\eta > 0$ is the income elasticity of housing demand, $\varepsilon_d < 0$ is the price elasticity of demand, and $\varepsilon_s > 0$ is the elasticity of supply.

$$(1) \qquad V = \sum_{t=1}^{\infty} \frac{R}{(1+r)^t} = \frac{R}{r},$$

where V is the value of the unit, R is the rent which is assumed constant over time, and r is the discount rate. The discount rate, r, is then generally postulated to be a function of various parameters such as the rate of depreciation, marginal tax rate, maintenance costs, etc.[15] In this case, to the extent that these parameters are constant over a given market, values should follow the pattern set by rents as in Figure 3, and capitalization rates should be constant over the income distribution.

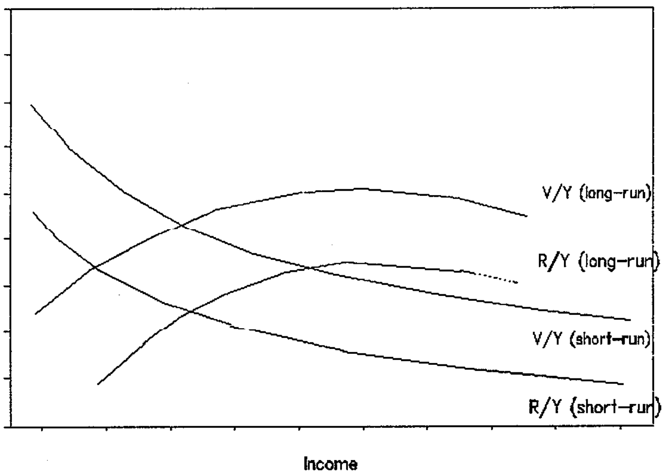

Figure 3

In order to consider tenure security, it is necessary to modify the above formula,

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[15] See Phillips[1988] and Swan[1984] for examples.

$$(2) \qquad V_0 = \sum_{t=0}^{T} \mathrm{E} \frac{R_t}{(1 + r_t)^t},$$

where V, R, and r are now subscripted by time.[16] The expectations operator signifies that future values are not known in the present.

Rewriting and rearranging Equation (2),

$$(3) \qquad \frac{V_0}{R_0} = 1 + \sum_{t=0}^{T} \mathrm{E} \frac{R_t*}{(1 + r_t)^t},$$

where $R_t^* = \frac{R_t}{R_0}$.

This implies that anything which is expected to have an effect on the ratio of future to present rent affects capitalization rates. Capitalization rates are also influenced through expectations concerning future discount rates and the expected life of the unit. For example, if tenure is not secure, there is a positive probability that the unit will be removed from the stock at some point in the future, implying a stream of zero future rents.

Expectations concerning the rent in time t are a function of the level of housing services provided by the unit, expected population and income changes, initial market disequilibrium, and the elasticity of the supply of housing, i.e.,

$$(4) \qquad R_t = R_t(h(\omega_{1t}, \ldots \omega_{nt}), \dot{P}, \dot{y}, \epsilon_s, \dot{\omega}, D-S)$$

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[16] Beginning the process in period 0 rather than period 1 is for convenience and does not affect the discussion.

where h is the level of housing services provided by the vector of characteristics $\omega_t = (\omega_{1t}, \ldots, \omega_{nt})$, $\dot{P}$ is the expected rate of change of population, $\dot{y}$ is the expected rate of change in incomes, ϵ_s is the elasticity of supply of housing, $(D\text{-}S)$ is excess demand for housing, and $\dot{\omega}$ denotes expectations concerning changes in the vector of characteristics ω_t. Note that,

$$\frac{\partial \mathrm{E}(R_t)}{\partial \dot{P}} > 0, \quad \frac{\partial \mathrm{E}(R_t)}{\partial \dot{y}} > 0, \quad \frac{\partial \mathrm{E}(R_t)}{\partial \epsilon_s} < 0, \quad \frac{\partial \mathrm{E}(R_t)}{\partial \dot{\omega}} > 0, \quad \frac{\partial \mathrm{E}(R_t)}{\partial \mathrm{E}(D-S)} > 0,$$

where $\dot{\omega} > 0$ implies an increased level of services from the vector of attributes. The effects of $\dot{P}$ and $\dot{y}$ on expected future rents are well known. This paper therefore concentrates on the other variables.

Individual housing characteristics in equation (4) are subscripted by time. This is because, in the informal sector, much housing investment is incremental in nature. The household often starts with a plot and a minimal unit for shelter, and upgrades the unit over time. This is therefore a generalization of the idea of depreciation, allowing depreciation to be either negative or positive.

One way to view this is through an analogy with a shoe factory. If a shoe factory receives a patent on a new, improved type of shoe, the price it charges for its product will not change until production is changed to the new model. However the value of the stock of the factory will immediately rise because of anticipated increases in future profits due to the new procedure. Ownership of the stock of housing in a unit is conceptually equivalent to ownership of a factory which produces housing services. To the extent that some characteristic of the production process affects future output, it can be expected to affect the price of the stock more than that of the services currently produced.

Assume that one element of the vector of attributes is correlated with the level of property rights, i.e. $\omega_t = h(\omega_{1t},\ldots,\omega_{nt}(\pi_s))$, where π_s is the level of tenure security in period s, for $s \geq t$. Assume further that the ω_{nt} is positively related to π_t, in other words that increased amounts of ω_{nt} imply increased security, i.e. $(\partial\pi_s/\partial\omega_{nt}) > 0$. This unrestrictive assumption holds for all of the examples mentioned above.

The total effect of a change in ω_{nt} on the value of the unit is,

$$\frac{dV}{d\omega_{nt}} = \frac{dV}{d\omega_{nt}} + \frac{\partial V}{\partial \pi_t}\frac{d\pi_t}{d\omega_{nt}} \quad (5)$$

The first term is the direct effect of increased amounts of the attribute on the value of the unit. This can be positive or negative depending on the attribute itself. For example, increased size of a squatter community can have negative effects on dwelling values due to crowding while also having an offsetting, increasing effect due to increased security attributable to greater political ability of the community to thwart eviction.[17]

The second term is the indirect effect of a change in the attribute through its effect as a signal of property rights associated with the unit. Insecure tenure implies that there is some possibility that the stream of future rents will be truncated before period T, resulting in the loss of the investment. Therefore, the lower is the expected life of the unit, the lower its value. In terms of equations (3) and (4), this implies that if the unit is demolished in period s, then $\omega_{it} = 0$ for all i and for all $t \geq s$. This is seen as a special case of the above discussion concerning the relationship between values and expectations concerning future output of housing characteristics of the unit.

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[17] Jimenez[1985]. For the proxies used in this paper $dV/d\omega_{nt} \geq 0$.

In addition to the increased security associated with an increase in π_s, the expected stream of future rents will also be affected by increased property rights for reasons such as anticipated increased access to credit and other services rationed on the basis of title.

In other words, property rights are a good which should have a positive price. Although it cannot be quantified, increased access to credit, infrastructure, and secure tenure, among other variables, implies that a household should be willing to pay more for a unit the higher the level of property rights embodied in it. The sign of $\partial V/\partial \pi$ is expected to be positive.

Expectations concerning the elasticity of supply are also important.[18] The supply elasticity of housing can be written as,

$$\epsilon_s = \frac{\sigma\, \rho_N + \tau}{\rho_L}, \tag{6}$$

where σ is the elasticity of substitution between land and non-land inputs, τ is the price elasticity of land supply, and ρ_N and ρ_L are the share of non-land and land inputs in the housing unit.[19]

Decreasing the elasticity of land supply or the elasticity of substitution between land and non-land inputs not surprisingly also decreases the total supply response to price changes. This is the mechanism through which squatters and informal units contribute to increased affordability. By moving onto illegal land, or land which is not zoned for residential uses, the household increases the supply response of land to price changes. By building with illegal materials or generally not conforming to building codes, informal households increase the substitutability between land and non-land inputs.

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[18] See Mayo and Sheppard[1991].

[19] See Muth[1969] and Renaud[1991].

This affects both the average level of value to rent ratios in the market, as well as the relative ratios within the market. On average, increased supply responsiveness results in expectations that demographic pressures will result in lower rent increases than would otherwise occur, implying that values will fall relative to rents. This is also true for a particular informal unit. If it is observationally equivalent to a formal unit, the rent should be similar. However the lower level of property rights associated with it will result in a lower unit value.

Finally, note that the interest rate in these expressions is subscripted for time. If the discount rate is expected to change in real terms with time, this also affects the capitalization rate of the unit. For example, in a country which is experiencing increasing financial repression it might be felt that alternative investment opportunities will become worse with time in terms of real return. If this is the case, the value to rent ratio should be higher than it otherwise would have been. Results on this are discussed below. If there are few attractive alternative investments, then these rates will be lower and values correspondingly higher.

The following sections of this paper examine the effect of tenure security on capitalization rates in a single market at a period of time in order to test the validity of the shape of the curve in Figure 3. These results are also compared with those from developed countries to comment on the validity of cross market effects through the elasticity of supply and availability of alternative investments.

DATA AND SURVEY

The data were collected in the summer of 1981 for a study of informal housing markets in Cairo, although the data were collected from both the formal and informal housing sectors.[20] The data collection consisted of three parts: a scanning survey, a detailed occupant survey and a series of in-depth interviews. Table 1 lists the values of variables used in the analysis along with their means and standard deviations.

There is a high level of non-compliance with land use and construction regulations in the Cairo housing market. About fifty percent of owner-occupied dwellings are informal.[21] There are a number of reasons for this phenomenon. The driving forces seem to be strong demand pressures accompanied by regulatory and legal constraints which effectively make the supply curve for formal housing extremely inelastic. Key areas of constraint are the land registration system, the building permit system, the housing finance system, and the infrastructure delivery system.

By contrast, fewer than twenty percent of owner-occupied dwellings are squatter units. Over fifty percent of squatter units were greater than twenty years old at the time of the survey. They are comparable in quality and infrastructure with unauthorized units due to their greater age. They are a more extreme, and seemingly older, product of the same types of land constraints as unauthorized units.

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[20] Mayo et al[1982].

[21] Recall from the introduction that the informal sector is comprised of unauthorized housing, which is in violation of building or land use codes, and squatter housing, which is housing located on land being occupied illegally.

Table 1

VARIABLE	OWNERS	FORMAL OWNERS	INFORMAL OWNERS	SQUATTERS	RENTERS
HHINCOME	1909 (3887)	2951 (5483)	1079 (1399)	903 (537)	1445 (1807)
VALUE	14812 (36696)	19898 (48708)	8772 (9807)	10094 (12349)	
RENT					152 (180)
HHINCOME (median)	960	1440	744	780	960
VALUE (median)	7000	8750	5500	7000	
RENT (median)					100
WATER	0.77 (0.38)	0.92 (0.27)	0.59 (0.50)	0.88 (0.34)	0.82 (0.38)
SEWER	0.83 (0.38)	0.89 (0.31)	0.74 (0.44)	0.94 (0.25)	0.91 (0.29)
TOILET	0.79 (0.41)	0.86 (0.35)	0.70 (0.47)	0.80 (0.40)	0.78 (0.42)
GROCERY	7.8 (8.1)	7.7 (9.7)	7.9 (5.8)	9.4 (6.8)	6.5 (6.3)
ROOMS	3.9 (1.8)	4.2 (1.9)	3.6 (1.5)	3.1 (1.8)	3.2 (1.3)
HOUSE	0.27 (0.45)	0.26 (0.45)	0.28 (0.46)	0.25 (0.45)	0.09 (0.28)
GT20	0.51 (0.50)	0.66 (0.48)	0.34 (0.48)	0.63 (0.50)	0.52 (0.50)
DISTANCE	6.5 (4.6)	5.6 (4.4)	7.6 (4.6)	5.7 (6.7)	6.8 (5.8)
GROWTH	0.18 (0.15)	0.15 (0.13)	0.21 (0.17)	0.12 (0.21)	0.15 (0.16)
LINGER	17.9 (12.4)	20.3 (12.3)	15.3 (12.1)	17.2 (12.8)	14.4 (9.8)
HHSIZE	5.3 (2.8)	5.2 (3.1)	5.5 (2.4)	5.4 (2.8)	4.8 (2.2)
UNIVERSITY	0.14 (0.35)	0.18 (0.39)	0.10 (0.30)	0.13 (0.34)	0.15 (0.36)
URBANORIGIN	0.83 (0.47)	0.81 (0.40)	0.53 (0.51)	0.81 (0.40)	0.69 (0.47)
Number of Cases	154	80	74	29	346

Problems with the land registration system stem from the proscription of conversion of agricultural land to urban uses. Price ceilings on agricultural products, strong demand for urban land, and an inelastic supply of urban land result in large differentials between the values of urban and rural land. These price differentials eventually become large enough to make it profitable to accept the higher risk of converting rural to urban land illegally. The result is a high volume of illegally subdivided land coming on the market.

The system of building permits is time consuming, of uncertain outcome, expensive, and inadequately enforced. As in many other cities in developing countries, the building regulations in Cairo are set at levels comparable with those in industrialized countries. This makes housing which conforms to the standards too expensive for most households. Moreover, the permit application process is time consuming and the outcome is uncertain.[22] Since enforcement is lax, many households simply do not bother to build within the legal framework.

Growth patterns in Cairo reflect these institutional constraints. From one half to two thirds of new units produced in the five years leading up to the data collection were new units added to existing structures. One constraint on the possibility of vertical expansion is the availability of infrastructure in the area. One aspect of property rights of owners is that they can control the density of their plots. The ability to increase the density is also related to the availability and quality of infrastructure to the plot.

Infrastructure is expensive and scarce. Adequate user fees are not collected and therefore the systems are not self-financing and must be heavily subsidized. This results in chronic shortages of trunk infrastructure. When a developer applies for a permit to subdivide a parcel, if the government cannot provide the development with infrastructure, it often denies the permit. The parcel is then often subdivided illegally. Therefore the rationing of infrastructure is also a determinant of whether or not a dwelling is formal. Eventual provision within an area can signal the government's de facto acceptance of the property rights of the household. The following sections examine the effect of their policy on the value of dwellings of squatter and informal households.

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[22] See Mayo and Sheppard[1991] for a discussion of the effects of the stochastic nature of the development process on the supply and price of housing.

Authorities in Cairo ration infrastructure on the basis of the legitimacy with which they view the development. This implies that the decision by government to provide infrastructure carries information on the legitimacy with which the government views the unit. This implies that one way to quantify the property rights associated with a unit in Cairo is through differences in infrastructure provision both at the level of the unit and the enumeration district. This is described below.

EMPIRICAL FRAMEWORK

A complication of the analysis described in Section One is that tenure security is not generally observable and must be proxied. In order to evaluate the risk associated with a particular informal dwelling the household uses certain dwelling and neighborhood characteristics as signals as described above.[23]

There are a number of attributes which can function in this way, and which vary from market to market. Age and size of squatter communities are two characteristics of squatter settlements which are widely perceived as conveying information on tenure security.[24] The previous section examined this question in the context of the Cairo housing market and suggested use of infrastructure variables to proxy property rights.

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[23] See Friedman, Mayo, and Jimenez[1988].

Equation (5) suggests that the effects of the infrastructure provision variables discussed in the section above can be separated into service and tenure effects in the empirical analysis. The models estimated are,

$$(7) \qquad \ln V_i = \sum_{j=1}^{k} \beta_j X_{ij} + \beta_{k+1} \, (\mathit{PCT\ INFRASTRUCTURE}) \\ + \beta_{k+2} \, (\mathit{INFRASTRUCTURE}) * (\mathit{PCT\ INFRASTRUCTURE}) \\ + B_{K+3} (\mathit{TENURE\ VARIABLE}) * (\mathit{PCT\ INFRASTRUCTURE}),$$

for owner-occupants, and

$$(8) \qquad \ln R_i = \sum_{j=1}^{k} \beta_j X_{ij} + \beta_{k+1} \, (\mathit{PCT\ INFRASTRUCTURE}) \\ + \beta_{k+2} \, (\mathit{INFRASTRUCTURE}) * (\mathit{PCT\ INFRASTRUCTURE})$$

for renters, where V and R are the value and rent of the unit respectively, the betas are hedonic coefficients, and the X matrices contain unit characteristics.

The service value of the infrastructure is proxied by the variable ***INFRASTRUCTURE*** which is a dummy variable equal to one if the unit is connected to the infrastructure and zero if it is not. The model is estimated twice, using water and sewerage connections as the infrastructure variable, so that ***INFRASTRUCTURE*** is ***WATER*** for model one and ***SEWER*** for model two.[25]

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[24] See Jimenez[1985].

Expectations about the future are proxied by ***PCT INFRASTRUCTURE***, which is the percentage of dwellings in the enumeration district which have water, ***PCTWATER*** (model 1), and sewerage, ***PCTSEWER*** (model 2).[26] The hypothesis is that increased incidence of infrastructure in an area conveys information to the market about units in the area.

The variable ***TENURE VARIABLE*** is a dummy variable which takes on the value one when the household is in a certain tenure group and zero when it is not. The two tenure groups used are ***SQUATTER*** and ***INFORMAL***. ***TENURE VARIABLE*** is (1 - ***SQUATTER***) in model (1a) and (2a) and (1 - ***INFORMAL***) for models (1b) and (2b).[27]

Table 2

Model Number	Dependent Variable	Tenure Security Variable	Infrastructure Variable
Model 1	Log of **GRENT**	N/A	**WATER**
Model 2	Log of **GRENT**	N/A	**SEWER**
Model 1A	Log of **VALUE**	**SQUATTER**	**WATER**
Model 1B	Log of **VALUE**	**INFORMAL**	**WATER**
Model 2A	Log of **VALUE**	**SQUATTER**	**SEWER**
Model 2B	Log of **VALUE**	**INFORMAL**	**SEWER**

For owners,

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[25] Table 2 lists all of the models estimated and describes them in terms of the dependent variable, infrastructure variable, and tenure variable.

[26] An enumeration district is approximately 200 contiguous units.

[27] Other independent variables are number of rooms in the unit (***ROOMS***), distance from the nearest grocery (***GROCERY***), distance from the central business district (***DISTANCE***), and dummy variables denoting whether or not the unit has a toilet (***TOILET***), whether it is a detached, single family unit (***HOUSE***), and whether it is more than 20 years old (***GT20***).

$$(7) \qquad \frac{\partial \ln(V_i)}{\partial\ PCT\ INFRASTRUCTURE} = \beta_{k+1} + \beta_{k+2}\ INFRASTRUCTURE$$

$$+ \beta_{k+3}\ TENURE\ VARIABLE > 0 \ ,$$

β_{k+1} gives the general change in value associated with a change in the expectations variable, its sign is expected to be positive. β_{k+2} describes how much over or under this premium households which are already connected are willing to pay for changes in the expectations. It is therefore the measure of the net service value of the change described above. If increases in the expectations variable signal possible future increases in the infrastructure service to the unit, this should be negative. In other words, households which already have connections should not be willing to pay for the possibility of future connections.

β_{k+3} describes how the value of a non-squatter dwelling is affected by the prevalence of infrastructure, and measures the tenure effect of the change in the expectations variable. If the expectations variable carries information on property rights, the sign of β_{k+3} should be negative, implying that the provision of infrastructure is valued less by those households with secure tenure.

For renters,

$$(7) \qquad \frac{\partial \ln(R)}{\partial\ PCT\ INFRASTRUCTURE} = \beta_{k+1} + \beta_{k+2}\ INFRASTRUCTURE = 0 \ .$$

This expression only measures the overall and service effects of changes in rents from the expectations variable. Both effects are expected to be zero because rents do not reflect ownership of the future stock as do values.[28]

EMPIRICAL RESULTS

In order to test and account for sample selection in the model, it is necessary to first estimate a tenure choice equation. The results reported here in part reflect the shortcomings of trying to reduce tenure to two categories, owner and renter. This dichotomy was maintained because of data restrictions.

PROBIT Results

Table 3 gives the results from the PROBIT equations used to estimate the tenure choice decision in models one and two respectively. In order to interpret these results, some discussion of tenure in developing countries is necessary. Owner-occupants in these cities are often segmented into high income, formal households alongside very low income squatter dwellings. Rental dwellings are more of a middle class phenomenon.[29]

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[28] In addition, sample selection is accounted for in the model through a widely used technique introduced by Heckman[1979,1978,1976], and analyzed by Lee[1983,1982,1979], Lee and Trost[1978], and Maddala[1983] which models sample selection bias as an omitted variable problem. This involves estimating a tenure choice model and including the Mills Ratio as a variable in the hedonic equations.

[29] An interesting extension of this research would be to estimate a sample selection model discriminating between squatters, non-squatter owners, and renters. Unfortunately this is not possible with these data due to degree of freedom constraints.

Table 3

	Model 1	Model 2
PCTWATER	1.346 (0.402)	
PCTSEWER		1.466 (0.479)
WATER	-0.430 (0.306)	
SEWER		-0.134 (0.402)
ROOMS	-0.135 (0.072)	-0.158 (0.074)
TOILET	0.013 (0.206)	-0.236 (0.220)
GROCERY	-0.025 (0.014)	-0.025 (0.014)
HOUSE	-0.660 (0.208)	-0.676 (0.213)
GT20	0.195 (0.167)	0.273 (0.163)
DISTANCE	0.004 (0.017)	0.017 (0.019)
GROWTH	-0.009 (0.565)	-0.031 (0.581)
HHINCOME	0.037 (0.093)	0.046 (0.093)
HHINCOME^2	-0.004 (0.005)	-0.004 (0.005)
HHSIZE	-0.002 0.035	-0.015 (0.036)
UNIVERSITY	0.262 (0.257)	0.234 (0.265)
URBANORIGIN	0.304 (0.144)	0.133 (0.152)
	333.2	318.9

In Model 1 the coefficient for household incomes is positive, although not significant, while that of the square of household incomes is negative and not significant. This is probably due to the high incomes of formal sector owners being balanced by the low incomes of squatters. The same is probably true for

HOUSE and ***ROOMS***, all of which have negative coefficients. The coefficient of ***TOILET*** is positive but not significant.

The coefficient of ***PCTWATER*** is positive, implying that dwellings located in neighborhoods with higher percentages of water provision are more likely to be owner-occupied than rented. This probably has something to do with expectations also. Dwellings which have water are more likely to be rented although the coefficient of this variable is not significant.

Older dwellings are more likely owner-occupied than rented, as are dwellings located farther from the central business district. Dwellings in high growth areas are more likely to be rented than owner-occupied. Households which are of urban origin are more likely to own than to rent, as are university educated and smaller households.

In model 2 ***SEWER*** is positive but not significant, while ***PCTSEWER*** is negative and insignificant. Most other coefficients remain unchanged, although ***URBANORG*** is not significant in model 2.

Hedonic Results

As discussed above, the results of the PROBIT regressions are used in order to compensate for the possibility of sample selection bias in the hedonic regressions. Tables 4 and 5 report the results of the hedonic regressions for owner occupants and renters respectively.

Consider the results for owners first. Models (1a) and (2a) seem to support the hypothesis that the expectations variables carry information on property rights. Neither of the coefficients denoting service effects is significant, while those of the overall and tenure effects are significant at over the 0.95 level and have the correct sign. What this implies is that, while all owners are willing to pay for increases in the expectations variables, squatters are willing to pay a significant amount more. Surprisingly, willingness to pay is not significantly influenced by whether or not the unit has an existing connection in model (1a), as evidenced by the insignificant coefficient of ***WATER***. This suggests that the tenure effect is the more important of the two, and that increased levels of infrastructure do carry information on tenure security as postulated.

The product of the expectations variable and infrastructure variable is significant for model (2a). It is negative in this model, implying that households already connected to the sewerage system are less willing to pay for increased levels in their area.

In addition to the expectations variables, the coefficient of ***GT20*** is negative in both models and that of ***GT20*SQUATTER*** is positive and the latter is larger in absolute value than the former in both cases, although they are only significant in model (1a). This implies that while, in general, older units are worth less,

older squatter units are actually worth more than newer ones. This suggests that age of the unit also carries information on defacto property rights.

In both models, the sum of the variables as defined in equation (7) are positive as expected. The equations using ***INFORMAL*** to model tenure security are not as successful in explaining values as those using ***SQUATTER***. This is not surprising given the differences in the type of insecurity for these tenure groups described above.

For renters, the results are quite different. Coefficients of the expectations variables in both models are negative and significant, although the absolute values of the coefficients are small relative to those in the value

Table 4

	Model 1	Model 2	Model 1a	Model 2a
INTERCEPT	6.228 (0.872)	6.008 (1.013)	5.615 (1.235)	(5.646 (1.165)
PCTWATER	3.329 (1.480)		1.092 (1.428)	
PCTWATER* WATER	1.462 (1.688)		1.895 (1.756)	
PCTWATER* (1 - INFORMAL)			0.770 (1.327)	
PCTWATER* (1 - SQUATTER)	-1.923 (0.928)			
PCTSEWER		9.953 (3.806		10.261 (4.258)
PCTSEWER* SEWER		-3.512 (2.022)		-4.364 (2.280)
PCTSEWER* (1 - INFORMAL)				0.072 (1.073)
PCTSEWER* (1 - SQUATTER)		-1.558 (0.889)		
WATER	-1.605 (1.050)		-1.713 (1.176)	
SEWER		-4.665 (1.796)		-5.435 (1.998)
SQUATTER	-0.540 (0.913)	-0.861 (0.923)		
ROOMS	0.426 (0.174)	0.691 (0.183)	0.349 (0.196)	0.669 (0.209)
TOILET	0.601 (0.425)	0.592 (0.445)	0.589 (0.474)	0.493 (0.529)
GROCERY	0.009 (0.029)	-0.009) (0.028)	0.026 (0.035)	0.003 (0.031)
HOUSE	-0.050 (0.510)	0.354 (0.537)	0.051 (0.571)	0.372 (0.592)
GT20	-0.215 (0.341)	-0.101 (0.329)	-0.062 (0.473)	0.007 (0.455)
DISTANCE	-0.048 (0.044	0.003 (0.044)	-0.052 (0.048)	0.016 (0.048)
GROWTH	0.441 (1.676)	-1.186 (1.539)	1.022 (1.941)	-0.786 (1.790)
GT20*SQUATTER	0.799 (0.992)	1.345 (0.942)		
GT20*INFORMAL			0.207 (0.789)	0.289 (0.773)

Table 4
(continued)

	Model 1	Model 2	Model 1a	Model 2a
NOBLDG	-2.099 (0.803)	-1.270 (0.799)	-0.872 (0.621)	-0.074 (0.591)
Mills' Ratio	-0.037 (0.528)	0.250 (0.613)	-0.055 (0.615)	0.231 (0.704)
$\bar{R}^2$	0.664	0.666	0.589	0.590
F	3.692	3.206	2.678	2.698

equations. One possible reason for this result is the fact that ***PCTWATER*** and ***PCTSEWER*** are both positively correlated with ***LINGER***. The coefficient of ***LINGER*** is negative and significant in both models, reflecting the tenure discount which is common in most rental markets. In any event, the expectations variables do not have the strong, positive effect on rents which they have on housing values.

The final point to mention concerning these equations concerns the coefficient of the Mills' ratio, included to test for the existence of sample selection bias. This coefficient is positive and significant in both renter equations, implying that rental units which have a higher probability of being owner-occupied have higher rents. Neither variable is significantly different from zero for owners however. This is most likely due to the differences between the different tenure groups which comprise the owner sample.

Estimating Capitalization Rates

These regression coefficients may now be used to estimate capitalization rates for individual dwelling units.[30] Table 6 reports median estimated capitalization rates by income quartiles for owners and renters. There are a

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[30] *NOBLDG*, a dummy variable with the value one if no part of the structure except for the unit is owned by the household, was left out of these regressions because it could not be estimated for renters.

Table 5

	Model 1a	Model 2a
INTERCEPT	3.915 (0.408)	3.347 (0.462)
PCTWATER	-1.092 (0.399)	
PCTSEWER		-1.250 (0.737)
WATER	0.036 (0.321)	
SEWER		-0.231 (0.407)
PCTWATER *WATER	0.300 (0.398)	
PCTSEWER *SEWER		-0.078 (0.168)
ROOMS	0.320 (0.046)	0.400 (0.057)
TOILET	0.207 (0.100)	0.444 (0.126)
GROCERY	0.019 (0.010)	0.032 (0.011)
HOUSE	0.120 (0.188)	0.439 (0.235)
GT20	-0.324 (0.101)	-0.505 (0.128)
DISTANCE	-0.053 (0.007)	-0.069 (0.009)
GROWTH	0.554 (0.302)	0.672 (0.307)
LINGER	-0.012 (0.005)	-0.012 (0.005)
FURNISH	0.371 (0.332)	0.336 (0.327)
Mills' Ratio	0.514 (0.309)	1.229 (0.428)
R^2	0.509	0.517
F	15.390	15.547

number of things to note about these values. First, they do indeed seem to be higher than would be expected from calculations for the United States. Linneman and Voith[1991] report values ranging from about seven to ten, and Phillips[1988] reports values from eleven to twenty-five. The values here are much larger,

Table 6

Income Quartile	Median Capitalization Rate: Renters	Median Capitalization Rate: Owners
Model 1		
1	18.6	37.0
2	15.6	34.8
3	18.1	45.9
4	25.0	78.5
Model 2		
1	23.6	35.3
2	23.0	35.5
3	24.8	24.4
4	25.0	94.5

ranging from fifteen to ninety-five.[31]

Over the income distribution, capitalization rate tend to rise. Figure 4 shows regression lines of capitalization rates against income for models 1 and 2. Note that, in contrast to the relationship implied in figure 3, this curve is positively related to incomes.

A Note on the Long Run

The above relationship is one which occurs for a given market at a point in time. No one has yet examined the long-run relationship between capitalization rates and economic development.

The first thing to discuss in this context is the difference between the marginal and average effect which property rights have on capitalization rates. The above results are for marginal effects on the values of particular units

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[31] Linneman and Voith and Phillips also used a different methodology, than that used here.

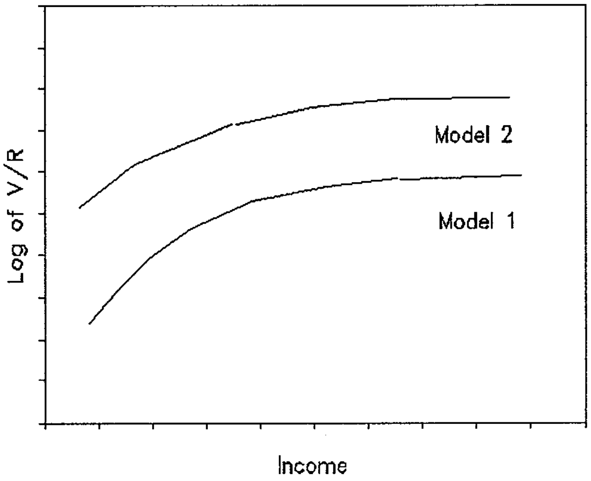

Figure 4

within a market at a specific point in time. While property rights can be expected to have effects on the overall level of values and at higher levels of incomes, these are likely to be weaker than those discussed above.

At least part of the premium for increased property rights connected with a unit is due to the relationship between the property rights of that unit and the average in the market. For example, consider two units which are observationally identical, the only difference being that one embodies a higher level of property rights. If the level of property rights embodied by the lower valued unit the unit is increased unilaterally, it is expected that its value should rise to that of the higher valued unit, whose value should remain unchanged.

If however, the level of property rights associated with all units were increased suddenly, it is not certain, or even likely, that the same type of price change would result. What seems more likely is that the values of informal units would rise, while those of formal units would fall. Overall the value of the housing stock should rise in this case, although by a smaller amount than would occur if the only effect were an increase in the value of each informal unit to that of a formal unit with similar characteristics.

This dichotomy explains the relative effects of property rights in the short-run, as discussed above, and in the long-run, as economic development progresses. As a country becomes wealthier the nature of the property rights issue becomes marginalized as basic security of tenure becomes more assured in general. The effect of the increased average level of property rights tends to raise average values, however is likely to be more than offset by macroeconomic forces driving the rent to value ratio closer to the level of interest rates, thus lowering the average ratio of values to rents. The conclusion is therefore that the long-run behavior of housing values and capitalization rates is not obvious a priori, and should be the subject of further research.

Figure 5 represents data collected as part of the Housing Indicators Program, a joint program of the United Nations Centre for Human Settlements and the World Bank. It graphs the difference between the logs of the median dwelling value and the median annual rent against the log of GNP per capita for 1990 in 52 cities around the world.

There are several points to be made concerning this figure. The first is that the slope of the relationship appears to be zero implying no systematic change in capitalization rates with income. In addition, the range of these values is quite large, with all points except Beijing located between ten and 100. This variation occurs for all income groups.

What this seems to imply is that, on average, values do tend to follow rents in the long-run, however there is a great deal of variation from the mean. One possible source of this variation is the functioning of the supply system in

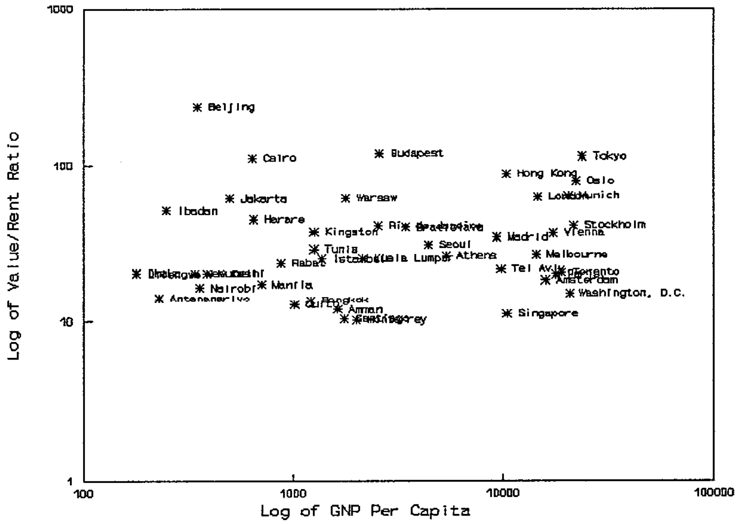

Figure 5

the market. Looking across the top tier of this graph, Beijing, Cairo, Budapest, and Hong Kong are all cities with very distorted supply systems. The relationship between the short-run results and the long-run is an important area for future research.

CONCLUSIONS

This paper examines residential capitalization rates and their relationship with property rights. Security of tenure is proxied by inclusion of variables denoting the percentage of units in an enumeration district with water connections (model 1) or sewer connections (model 2). It is found that these variable are positive and significant for owners, and negative and significant, though small, for renters. This latter result is probably because these variables are correlated with tenure discounts which accrue to renters.

The principal policy implication of this analysis is that the informal sector is both easier and more difficult to deal with than is often realized.

It is easier in the sense that it reacts to the same stimuli as any other market. It is often a productive sector in which participants are willing to devote substantial amounts of their own resources to upgrading and improving their investment. In this sense, governments can best help by providing secure tenure and clear property rights, while devoting scarce resources to the poorest segments of the market.[32]

It is more difficult because most governments will find it necessary to change their way of thinking to pursue this type of policy. Active public involvement in production and maintenance along with unrealistically high building and land use standards have been the midwife to the birth of the informal sector. They are unlikely to be a part of the solution.

Finally, this paper asserts that capitalization rates are an important entry point for understanding housing markets. Although much of the literature on housing deals with the issue of tenure choice, there is an inadequate understanding of the forces which drive the relative prices of housing stock and the services they produce. An understanding of these forces is a key to an understanding of housing markets.

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[32] See Renaud[1984].

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